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Diagnostic Potential of Phase-sensitive Radiography

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Phase-sensitive imaging is based on the use of information arising from the modification in amplitude and phase of x-rays as they traverse an object. This allows the detection of properties, such as x-ray refraction, which is not possible with conventional radiography. Thus, detection of tissues and tissue properties that do not garner contrast through x-ray attenuation, especially at high energies where radiation dosage is reduced, is made possible through phase-sensitive imaging. Tissues that benefit from this imaging parameter are the soft tissues that do not have the elemental make-up for x-ray attenuation. The phase-sensitive technique that is used by our laboratory is an analyzer-based system called diffraction enhanced imaging (DEI), whereby an analyzer is positioned between the object and the detector to allow changes in x-ray angle to be converted to changes in x-ray intensity at the detector. By altering the angle of the analyzer both refraction and absorption can be recorded. Our laboratory has applied DEI to the detection of cartilage lesions of early osteoarthritis that are invisible with conventional radiography. We have shown, with x-rays from both the synchrotron and a compact source that DEI allows the visualization of soft tissues and their associated lesions.